Minutes of Ocean Observations Research Coordination Network (RCN) meeting

San Francisco (at Marriot Marquis Hotel)

December 8, 2013

Jay Pearlman introduced the agenda.

1. Welcome, Introductions by Participants and Status Update– Jay Pearlman

2. Geosciences grand challenges – Panel on visions for the ocean – Moderator Mary Jane Perry, University of Maine

   David Conover, NSF, Ken Denman, ONC, Dawn Wright, ESRI

3. Panel on International Cooperation - Moderator Chris Scholin, MBARI

   Maria Uhle, NSF, David Krasa, European Research Council Executive Agency, Ken Denman, ONC, Simon Allen, CSIRO

4. International Collaboration (continued)

   Christoph Waldmann, COOPEUS, Hans-Peter Plag, GEO, Mairi Best EMSO

5. Data Systems Moderator – Albert (Sandy) Williams 3rd, IEEE

   Pierre Bahurel, MyOcean, John Orcutt, OOI, Helen Glaves, ODIP, Mark Parsons, RDA

6. Panel on Sensors/Observations – Biology and Chemistry - Moderator Jim Yoder, WHOI

   Jim Yoder, WHOI, Eric Delory, PLOCAN, Kendra Daly, USF, Ken Johnson, MBARI

7. RCN Plans for 2014 – Moderator Jay Pearlman, IEEE

   Jim Yoder, Eric Delory, Christoph Waldmann, Simon Allen, Sandy Williams

8. Summary – Sandy Williams

Following an overview of RCN activities by Jay Pearlman, the participants introduced themselves (see attachment 1 for attendees).

**Geosciences Grand Challenges – A panel Discussion**

*Mary Jane Perry*, University of Maine, introduced the Panel on the Geosciences Grand Challenges. The panel included Dawn Wright, Esri, Ken Denman of Ocean Networks Canada and David Conover, NSF. In her introduction of the panel, Mary Jane noted that from a social and environmental question, there are significant changes in society and science from technological changes, climate changes, human perturbations and even citizen science. From a technical perspective, a major challenge is the uncertainty of calibrations in sensors that put observations in doubt on occasion. This is particularly important for long-term measurements and studies with multiple sensors.

*Dawn Wright*, Esri Chief Scientist gave the first presentation. Esri is a for-profit company supporting multiple dimensions in Web Map Services (WMS) implementation of ArcGIS for Server implementation. In her discussion in which the grand challenges have been discussed recently. Dawn described Ocean Exploration 2020, a National Forum. Also, the Schmidt Ocean Institute Science Symposium held an Ocean Data Sharing symposium. Grand Challenges included moving seamlessly from data discovery to vision and back. Is vision complete? If not, what is needed? A Grand Challenge is not only discovery of the data but data analysis. As data sets become larger ("big data") and processing becomes more complex, new analyses paradigms are needed. An attractive, though uncommon solution at the moment is to "Stop moving the data to algorithms, but push algorithms TO the data". This can be done by putting software into a

Web Browser to perform, for example, ArcGIS analyses online. Dawn recommends consolidating best practices, which she notes have been published to Resource Center. Sharing analyses as well as data is called a Geoprocessing Package or Service. An interesting example is the Esri GEO Portal, which provides a bridge between the Global Earth Observation System of Systems (GEOSS) and ArcGIS Online user community. GIS tools for Hadoop are to be applied to spatial data (Hadoop is presently a financial application). Another challenge she pointed to is lack of formal accredited academic degrees or curricula in ocean data management.

*Ken Denman*, Head Ocean Networks Canada (ONC): ONC has the cabled observatory Neptune running out to Endeavour Ridge west of Vancouver Island and the cabled observatory Venus (in the Salish Sea east of Vancouver Island). The network has tracked tsunamis and the Venus observatory observed the tsunami height coming into the Salish Sea. Operational oceanography is being done in the Strait of Georgia. The Arctic Observatory in Cambridge Bay (Canadian Arctic) observes ice thickness (unless a barge is parked over the sensor). There are 5 research themes including: 1) Understanding human-induced change in the Northeast Pacific Ocean; 2) Life in the environments of the Northeast Pacific Ocean and Salish Sea; 3) Interconnections among the seafloor, ocean, and atmosphere; 4) geo hazards**.** The impacts of climate range shifts and the resultant following of ocean life toward suitable habitats is ten times as fast in the ocean as on land; composition of ecosystems will evolve as cold lovers move north. In addition, the pH of the oceans is decreasing as $CO_2$ goes into the upper ocean. These changes are likely to have significant impacts on fisheries with projections that as high as 90% of commercial catch value is at risk in New England and 70% in Alaska. From this perspective, Ken identified a number of Ecosystem Observation Systems concerns. Some of the significant challenges and gaps are in Ocean Physics and Engineering – the needs for more comprehensive and complex measurements. For example, biology needs observations of vertical transport processes. For Ocean Ecology, micro zooplankton populations are tightly coupled to phytoplankton through grazing. Most rates need to be determined continuously and/or automatically, especially 'secondary production' by zooplankton. To meet these challenges, instrumentation requires low power, low maintenance, robustness and reliability.

*David Conover*, head of Ocean Sciences, NSF: In considering the ocean science challenges, we must address the culture of ocean sciences. Climate change is only one of the big changes we are seeing on the planet. Ecosystem-based management is the base of our regulatory environment. We have to play ecological detective to explain why things change so much and that requires observations to determine how things have changed. The consequences of extreme events need to be examined. The need for observation and analyses grows and the NSF programs must adjust. Hazards Seas is a new NSF program but it will need to be expanded. Ocean acidification research funding is coming to the end at NSF. Constraints moving forward from the NSF perspective include balancing infrastructure and science research. We have new infrastructure and instrumentation but we aren't taking any old infrastructure away. This results in struggles at NSF. The infrastructure fraction of the budget has now exceeded individual investigator support. Direct consideration of what it will cost to operate a program is going to be required. Also how much it costs to maintain the data and digitize and manage the databases will have to be projected.

All federally collected data must be made available to the public and the cost of this will be borne in the future as data quantity expands. 'Web of Science' can find literature anytime, but what about data? We need the 'Web of Data'. Data citation is as much needed as citation of scientific papers. The evaluation metric of how many papers a person has produced needs to be

augmented by how much data has been archived and served. New opportunities are private/public partnerships. James Cameron and Wendy Schmidt have provided resources to science. The ship time is free but nothing else. We need to train citizen scientists. There is an Open ROV initiative where anyone can build his/her own ROV from open source documentation. These ROVs cannot now serve science well but their capabilities will expand with citizen participation.

The Horizon EU 2020 proposal for research in the North Atlantic encourages partnerships between Europeans, Canadians, and Americans. How we function as a community is the final point. The community has a fractionated approach to advancing ocean science. Which priorities can we afford? Funding agencies have to set priorities themselves. But NSF has an AGU Town Hall on this topic at the AGU meeting this Thursday to engage with the science community. An NRC Decadal Survey of Ocean Sciences will make recommendations.

**Discussion with Panel and meeting attendees:**

In a reflection on Conover's comments, Ken Johnson of MBARI suggested that a paragraph in each NSF proposal should be required to note where the data are to be stored. Hans-Peter Plag of ODU raised the observation that it is people, not technology that is the issue. We have more exposure in risky places. He pointed out that there are more people at risk not just because the hazards are worse but also because there are more people. We depend on electricity, food supplies at stores, and computer infrastructure to survive. David Conover wants to support the situation that Hans-Peter refers to, that we are in a crisis all of us need to take action on, because by the time the danger is a 'no brainer' to the general public it is too late. With respect to observations and ship time, Simon Allen noted that ship time could be made available in Australia. Chris Scholin asked how ship time could be used with NSF proposals when R/V FALKOR time is free? In comparing government and private foundation support, David said that private foundations have the benefit that they do not have to take proposals from everyone; they can solicit proposals from individuals in areas they are specifically interested in.

**Panel on International Cooperation**

*Chris Scholin* MBARI Director and microbiologist, moderated for the Panel on International Cooperation. Panel members are: Maria Uhle, NSF; David Krasa, European Research Council Executive Agency; Ken Denman, ONC; and Simon Allen, CSIRO.

*Maria Uhle* provided an overview of international initiatives for collaboration including the Belmont Forum International Opportunities Fund, NSF Programs such as SAVI and Future Earth. Maria introduced the Belmont Forum as a way to deliver knowledge needed for action to mitigate and adapt to detrimental environmental change and extreme hazardous events. From this perspective, there are three foci:

- Effective integration and coordination mechanisms to address interdependencies and marshal the necessary resources
- Information on the state of the environment, through advanced observing systems
- Assessments of risks, impacts and vulnerabilities, through regional and decadal analysis and prediction

The Belmont members include 16 nations and international organizations. The Forum's International Opportunities Fund includes a number of sponsored research areas; on-going projects are Freshwater Security, Coastal Vulnerability, E-Infrastructures, and others. Future Earth is an international research program focused on global sustainability, addressing Dynamic Planet, Global Development and Transformations towards Sustainability. Ultimately, the program will provide end-to-end capabilities from observations to decision. There is a single secretariat but four or five countries can work together. NSF International Partnerships exist to support science across virtual institutes. Funding is provided to create research partnerships, faculty exchanges, organized workshops; $50k to $400k grants are available for projects like COOPEUS (http://www.coopeus.eu), a joint program of the US and the European Commission. COOPEUS is funded through the NSF "Science Across Virtual Institutes (SAVI)" (www.nsf.gov/savi).

*David Krasa* of European Research Council Executive Agency (ERCEA) is concerned with building up *in situ* observational capabilities. Copernicus is one of the European drivers of ocean science with remote measurements of salinity among other satellite observations. Observations are delivered under MyOcean, which provides marine resources and seasonal forecasting. This international effort is delivered as a resource to the Group on Earth Observation through GEOSS. Europe is transitioning from the seventh framework projects (FP7) to Horizon 2020, which will last through the end of this decade. FP7 is examining the emergence of the citizen as a new component in earth and environmental observations (through mobile technology). There are four citizen research projects currently being funded (http://citizencyberlab.eu/about/). These include approaches to citizen observation, cheaper sensor technologies, and demonstrations. Horizon 2020 has Blue Planet, which is a program of monitoring the entire Atlantic Ocean. High latitude monitoring is an environmental gap that is important to fill. Other EC activities include COOPEUS, mentioned before by Maria Uhle. January 16, 2014 will have a meeting on Integrated Atlantic Observation (Blue Planet) in Geneva. Bottom up proposals from the research community will be supported in Horizon 2020. Interdisciplinary research will be favored at ERCEA with €13M funding available.

*Ken Denman* of ONC, in addressing international collaboration, provided information on data access; there were 276,000 visitors to ONC websites, 63% were returnees, 670 days were spent in total online time. A workshop on integrating observatories in the Pacific Ocean that was recommended in June 2013 is being planned. It will establish ways to share data and cooperate in other ways. Private foundations like Moore and Schmidt have supported international programs. ONC has gotten ship time on the R/V FALKOR for an observatory under a glacier as a baseline study.

*Simon Allen* of CSIRO said a lot of good ideas are not 'eureka' but 'hmm'. Australia through IMOS has a national, collaborative, research infrastructure funded by Australian Government. It provides the vehicle through which multiple institutions undertake sustained observing of the marine environment, making all of the data openly available for research and other purposes. IMOS is integrated from the open ocean, onto the shelf and into the coast and across physics, chemistry, and biology. IMOS has been designed to address big science questions posed through a series of Nodes, which bring together the research community and various stakeholders. It has been implemented through a portfolio of technologies and platforms, called Facilities, which are operated by multiple Institutions. All of the data are made available though a single national marine information infrastructure called the Australian Ocean Data Network (AODN). Institutional Connections around Australia have nodes and gliders and this coordination has created a real relationship with other institutions around Australia. There are RADAR connections and SCOOP among many institutions. Connections do go to other places in the world and are included in the National Science and Implementation Plan 2015-2025. R/V Investigator has unused capacity because there are too few Australian ocean scientists. So there is space available and ocean technicians can deploy instruments to make observations for you.

**Discussions following Panel Presentations:**

Dawn asked Simon if IMOS staff could be approached using the IMOS webpage. Simon will provide connections. Ken Johnson asked if Americans could use the Australian facilities. We in the US have been told to turn off data streams from floats when the floats enter foreign waters. Maria Uhle said it is best to get your sharing arrangements together before seeking Belmont support. A little money in advance can get this started, but every researcher needs to get grants to fund his/her own research, Belmont can only get the collaboration meetings funded. Chris said that there is a proliferation of acronyms, agencies, and other entities that baffle many and asked if there could be a roadmap to name and identify them. Jay asked Maria what international engineering organizations exist. Maria said that without engineers we couldn't get ahead. So Belmont says engineers are included as long as there isn't a bar (e.g., NIH funding would be such a bar).

**Lunch**

**Panel on International Cooperation (continued)**

*Chris Scholin* continued a second round of the Panel on International Collaboration. This panel included: Christoph Waldmann, COOPEUS; Hans-Peter Plag, GEO; and Mairi Best EMSO.

*Christoph Waldman*, MARUM in University of Bremen, presented the COOPEUS project: the mechanism was proposed in Rome for fostering Transatlantic Cooperation with access to US and EU Research Infrastructures in the environmental field to maximize scientific data exchange. It is one project with aligned EC funded and NSF funded components. It is to have open data access within and across domains. The project is focused on Cyber/E-infrastructure concepts and implementations in five scientific disciplines: Space weather through ionosphere observing radars, ocean observations, biodiversity, solid earth dynamics, and carbon observations. Each has a European Union project and a USA corresponding project. There are 15 partners with 6 from the US and 9 from the EU. The COOPEUS methodology uses common data policies and standards and services. There is a common RI framework and policies (practices, principles, and policies). There will be an analytical phase, intermediate synthesis, user scenarios, and final synthesis. User scenarios: selection process

is split into different levels, identify scientific needs (integrations of observations, share common methods and tools), look for collocated infrastructures (to address phenomena occurring at the same locations), make use of synergies, and promote concepts that help (unify data quality, data policies and harmonize IPR) with the goal of improving the discovery of data having the highest priority. GEOSS interaction is at three steps: registering of standards, getting the data into GEOSS infrastructure, and providing functionality as a broker for the user community. The role for COOPEUS is to address the challenges on how to maintain visibility of data, preservation, integrity, authenticity, provenance, and privacy.

*Mairi Best* from EMSO spoke about how data from the Venus observatory can be made available. EMSO is the European research Infrastructure for oceans and there are 21 projects feeding into EMSO and its formation; ESONET and EMSO from Framework 6 and Framework 7 were the most important. EMSO is currently addressing both selection of key observatory sites as well as integration of the community. EMSO nodes are from the Nordic Sea and Arctic to the Mediterranean and Black Sea. There are about a dozen cabled observatories collecting benthic and slope environments. EMSO provides power, communications, sensors and data infrastructure for continuous, high-resolution, near real-time, interactive ocean observations. EMSO consists of a truly multi-and interdisciplinary range of research areas including biology, geology etc. Common design of a generic sensor module across geosciences is a goal, including physical oceanography, biogeochemistry and biology. The EMSO-ERIC [http://www.emso-eu.org/about/emso-eric.html] is a legal entity signed by 10 countries with three more in the works.

*Hans-Peter Plag* of ODU talked about Blue Planet and how GEOSS can access environmental intelligence for making decisions. Sustainability of development in the coastal zone is one of the front lines of human sustainability. The GEO Coastal Zone Community of Practice (CZCP) brings together experts in an effort to support integrated coastal zone management in the Mediterranean, Africa, and the Caribbean. It started June 2008 in Athens with an initial focus on the Mediterranean. Capacity building and retention in Africa was most important. In the Caribbean, the needs were for an information system that supported a broad range of users, not just the scientists. Services are now part of the coastal zone plan including natural environments such as mangroves coral reefs and estuaries. Hans-Peter emphasized that Oceans and Society together are in Blue Planet.

**Data Systems Panel**

*Sandy Williams*, WHOI moderated The Data Systems Panel. Panel members are: Pierre Bahurel, MyOcean, John Orcutt, OOI, Helen Glaves, ODIP, BGS and Mark Parsons, RDA.

*Pierre Bahurel* gave a presentation of MyOcean (remote by phone). He covered three areas:

The framework for developing operational oceanography in Europe
How operational oceanography users pull the need for observations today
How observations impact operational oceanography products today.

He explained that what was formerly GMES became Copernicus recently. It includes ESA Sentinel 3 and EUMETSAT Operational Satellites. MyOcean includes *in situ* supporting measurements from Euro Argo floats, and Core Services (Marine being the only example that was in our area of interest). Its creation and operation supports needs for observations expressed by users, 3000 users from 1000 organizations in 92 countries. They also wanted sustainability. 50% of them were from the research community. In 2012, there were an average of 30 000 requests/month with 1.1 Tbytes of downloaded data. This was done with a mean reliability of greater than 96 percent. The development of in situ measurements continues. Euro-Argo floats have been successful. They measure salinity and have reduced the salinity error by 70% for 7 days observations. The current program, "MyOcean2" will transition into an EU Marine Service. Activities supporting this cover a wide range including: 1) organization - With EuroGOOS, secure data collection and management at global and regional, and link Copernicus (MyOcean) with other EU initiatives, and EU agencies (e.g. EEA); 2) infrastructures: with the EuroArgo ERIC infrastructure, propose framework for long-term EU support and funding; and 3) services: with the Marine Service, foster User uptake and awareness of EU Member States of the importance of ocean observations.

*John Orcutt*, SIO, gave a presentation on the OOI cyber infrastructure. The OOI network requires 25 to 30 year sustainability. Cyber infrastructure must facilitate the use of capabilities for deployments in the Argentine Basin, Irminger Sea, Station Papa, Pioneer Array, Chile, and the RSN cabled observatory of Washington State. Data are transmitted between Seattle, Portland, and San Diego at 10GBit/s. OOI is a deployment of 750 instruments of 60 different kinds. The data are disc-stored and real-time transmitted with latencies of only a few seconds. This rate extends from better than 1 Hz out to climate time scales of 25 years. In response to this demand, there is a new course taught at Scripps – Scientific Computing. 25 mostly first year graduate students are taking it.

*Helen Glaves* of BGS presented background on the Ocean Data Interoperability Platform (ODIP) ODIP in an information/infrastructure Interoperability Program that was 5 years in the making. It uses a multidisciplinary ecosystem level approach, in contrast to a traditional discipline-based approach. This includes the challenges of research data needed from other disciplines to address the science grand challenges involving the oceans. In point of fact, data were already out there. It had cost €1.4B to capture these data in 2011. They need to be reused. But issues to do so include formats, standards, best practice, coordinate systems, and national and organizational policies. E-infrastructure has developed data management infrastructures but requires a common approach to marine data management. ODIP is a jointly EU-US-Australia initiative. The US part is R2R which is an NSF supplement, **IMOS** in Australia, and **IODE** an international collaboration effort. ODIP objectives are:

1) To establish an EU/USA/Australia/IOC-IODE co-ordination platform to facilitate the interoperability of ocean and marine data management infrastructures

2) To demonstrate this co-ordination through the development of several joint EU-USA-Australia-IOC/IODE prototypes that would ensure persistent availability and effective sharing of data across scientific domains, organizations and national boundaries

3) To develop a common approach to marine data management that can be extended to other regions and organizations beyond the original project consortium.

Underlying these objectives is an approach is to bring people together on small projects including use cases in areas such as: inventories of existing standards and policies, workshops to develop interoperability solutions, prototypes for testing, and promoting interoperability more widely. A workshop, the 1st ODIP workshop, was held at Ostend 22-25 Feb. 2013 with 46 participants with 6 topics: Common vocabulary, metadata formats for discovery, and four more. There were 3 tasks selected: ODIP1, Interoperability between Europe, Australia, and US; ODIP2, Interoperability between regional cruise summaries; and ODIP3 Sensors Observation Service and common O&M + Sensor ML profiles. 51 came to the workshop in San Diego.

*Mark Parsons* of the Research Data Alliance (RDA), which is an international collaboration for creating the culture and technology for an international data infrastructure. RDA's vision is to create bridges in the research community for openness, consensus, balance, and harmonization. It is community driven, and non-profit. The RDA structure consists of interest groups and working groups. The former is a sustained collaboration in technical areas. Interest groups may form working groups to address a specific issue over a period of no more than 18 months. The working groups have goals with specific outcomes. Examples of working groups include: Data Type Registries WG; Persistent Identifier Information Types; Practical Policy; Metadata Standards; Data Categories and Codes; Data Foundations and Terminology; and others. The working groups provide a status to semi-annual RDA Plenaries with meetings in Dublin and Amsterdam in 2014.

**Panel on Sensors/Observations – Biology and Chemistry**

*Jim Yoder* moderated the Panel on Sensors/Observations. Panel members included Kendra Daly, Eric Delory, Ken Johnson, and Jim Yoder.

*Jim Yoder* of WHOI presented information about new satellite sensors: SWOT is a wide swath NASA altimeter. It will produce data giving a measurement of water storage and link into coastal oceanography. SWOT samples three times a month. PACE/OLCI from NASA/ESA is a high spectral resolution radiometer. Its ocean color scanning can detect harmful algal blooms by ultraviolet emissions characteristic of proteins in these organisms. Ocean color

radiometers are in geostationary orbits (S. Korea has GOCI covering the East China Sea, others are planned). This means there is an image every 30 to 60 minutes.

*Eric Delory* of PLOCAN described the NeXOS project that is part of Framework 7. The four-year project was started recently with a focus on the next generation of in situ ocean sensors (and systems). PLOCAN in the Canary Islands is the coordinator with partners throughout Europe. NeXOS addresses optical and passive acoustic sensors for *in-situ* monitoring of the marine environment and related maritime activities such as environment, fisheries. For example, in addition to support ocean research, fishing activities (RECOPESCA + EAF) need sensors for fishing nets and vessels. NeXOS needs to reduce the cost of observations and enable better cooperation between key sectors. Through a series of work packages, the project will build, integrate, test and deliver sensors that have common standards and improved interoperability for multi-functional (multi-sensor) applications. Main drivers are performance, cost, robustness, and bio fouling resistance. Transversal innovations require materials and production techniques. Demonstrations will be done on vessels, platforms, buoys, gliders, and profilers. Dissemination and outreach will support user interfaces and feedback. GEOSS data sharing principles will be followed. Practical experiences including the successes and failures will be documented.

*Kendra Daly* of University of South Florida presented challenges and innovations in chemical and biological sensors. Challenges are the need to accelerate sensor development given the long time frames (up to 10 years) to bring sensors to operational status. Few biological and chemical sensors are ready for long-term deployment on observatories. Rigorous field validation is needed for most sensors but collaboration between SeaBird Scientific, Satlantic, and a third commercial partner has tried to address this need. Standards are needed. Commercially available instruments are not as good as people would like. A way to calibrate sensors is needed. Sensors for acidity need temperature as well as pH to be meaningful and people don't always measure temperature or log it. The way the sensors are mounted makes a difference and people don't always indicate mounting method or location. An International Time-Series Methods Workshop in November 28-30, 2012 was so popular that people were turned away. The Wendy Schmidt X-Prizes for two types of pH sensors, one excellent and the other cheap, were offered. Three more Wendy Schmidt X-Prizes are in the works. There is now a 3D holographic camera that works as deep as 6000m. Adaptive sampling for profiling on a mooring is a priority. A deployment at Ocean Station Papa was the Surface Piercing Profiler. The OOI RSN cabled system has a shallow water profiler. Some sensors are fast but some are slow and require stepped profiling to not have measurements smeared. Clearly there are a lot of opportunities in this area.

**Discussion following the presentations:**

*Christoph Waldmann* of MARUM was interested in the role of the national metrology office in the US [NIST]. In Europe there is a national metrology project. Optical instruments were helped by NIST. Ken Johnson from MBARI wanted to give us a glass half full picture; we can deploy bio and chemical sensors that work at global or ocean basin scales. Observing system designs must be statistically defensible – large networks of sensors deployed globally. They are disposable and stable for years, low power, low cost, operated through large pressure and temperature ranges, sensitive and precise and include: Argo, BioArgo with oxygen, and biological sensors. All data are open and accessible. These can observe the metabolism of the ocean. $O_2$ and nitrate observations were reported in Nature for three-year chunks. Now pH

sensors are on floats. There are still challenges in recognition of data publication. Greenland Sea data from the Argo floats were analyzed and published by WHOI without attribution to the source of the data. There is also a need for longer term monitoring; a BioArgo challenge is needed for the five-year picture with global coverage. Simon Allen asked about quality of observations indicating chlorophyll and Mary Jane said that redundancy is the secret and doing it at night helps because there is no photo quenching of fluorescence. Denman asked if there is a sensor for argon. Johnson responded that there is an argon sensor, but it is slow. He believes that oxygen production seasonally at the surface can be used as a surrogate with the belief that production equals consumption and remineralization. There was some discussion between Craig Lee of UW and Ken Johnson about cost of floats vs. cost of ships. Both are needed. Mary Jane Perry asked if there was no call for zooplankton sensors. Eric Delory said he was not aware of any. Dawn asked if we lose 700 floats a year, what the report to the public about them is. Ken pointed out that it is small compared to losses of containers each year.

**Working Groups**

*Simon Allen* moderated the panel on Working Groups.

*Jim Yoder* from WHOI leads the RSS vs. In Situ Working Group. He has formed his group and they have been exchanging emails but he observed that one person writes the report. The satellites have already been spoken of but Jim added that there is a need for a near surface type of Argo float (shallow profiling) to do coastal work.

*Eric Delory* and Christoph Waldmann lead a Sensor Working Group addressing sensor requirements. It would be worthwhile to compile information about best practices.

*Sandy Williams* from WHOI and *Simon Allen* from CSIRO reported on the Webinar series where about one Webinar each month is given for free through the web. The purpose is Outreach and Capacity Building but in fact these Webinars have been given by stellar scientists and engineers and serve more as inspirational talks. Alternative strategies have been discussed to entrain youth into science from third world countries where capacity needs to be built. A series based on Open Courseware has been discussed with a lead lecture for such a course given as a Webinar to entrain those who might otherwise not follow a scientific path in college. It was pointed out that there needs to be some type of scientific course locally (at a national level) to sustainably attract such students. And the greatest need for capacity building is in data management where the demand will be greatest in the future. Dawn said the archived Webinars are good.

**Summary**

*Sandy Williams* summarized the RCN meeting by remarking that the Grand Challenges talks were inspiring and exciting and that the reports of International Cooperation and Collaboration through various international programs were informative. Progress with the working groups and the great success and data management requirements of modern oceanographic programs was exposed and described. The participants agreed that future face-to-face RCN meetings should continue to be held on the Sunday prior to the AGU Fall meeting in San Francisco.

**Attachment 1**
Attendees at the December 2013 RCN Meeting